

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-6, 8, 10-12, and 14-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,728,494 B2 to Numata et al. in view of U.S. Patent 6,864,761 B2 to Eskeldson et al.

As to **Claim 1**, *Numata* discloses a light emitting device (LED) circuit, comprising (Fig. 1, LED drive circuit):

an LED (Fig. 1, 15) manifesting a first frequency response curve property (LED has a bandwidth of 100 MHz, Col. 2, ll. 15-22); and

a driving circuit (Fig. 1, various resistors, capacitors, and transistors) for the LED having an output signal that manifests a second frequency response curve property (Col. 3, ll. 25-31; the bandwidth limitation of the LED is compensated by the compensation circuit, thus the driving circuit must have a 2nd frequency response curve property),

While disclosing bandwidth compensation for the LED, *Numata* does not expressly disclose the driving circuit output signal for driving the LED wherein the second property manifests a frequency response curve opposite to the first frequency response curve property of said light emitting device.

Eskeldson discloses pole-zero compensation for an element with an undesired bandwidth limitation. Fig. 8b illustrates the frequency response of the device to be compensated. Fig. 8a shows the frequency response of the compensating circuit, which is an RC circuit as disclosed by *Numata*. Inspection of Fig's. 8a and 8b shows that the frequency response curves are opposite each other.

Numata is from the same art with respect to optical communications. *Eskeldson* solves the same problem with respect to bandwidth compensation. Therefore, *Numata* and *Eskeldson* are analogous art.

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to adjust the compensation circuit disclosed by *Numata*, such that its frequency response curve is opposite the frequency response of the LED. *Numata* suggests bandwidth compensation for the LED.

As to **Claim 2**, *Numata* discloses said driving circuit comprises a power amplifier having an output signal (Fig. 1, compensator 11 and transistor Q12.)

Eskeldson discloses that the frequency of compensation zero is controlled by a known relationship (Col. 6, ll. 52-6.)

It would have been obvious to set the gain curve of the driving circuit to start from the cut-off frequency of the LED. A person of ordinary skill in the art would have been motivated to optimize the frequency of the compensation circuit that produces the best result.

As to **Claim 3**, *Numata* discloses said amplifier comprises a frequency generating unit for generating a signal manifesting a desired frequency (Fig. 1, 11) and a current multiplier unit constituted by a current mirror circuit (Fig. 1, 13.)

As to **Claim 4**, *Numata* discloses a driving method for driving a light emitting device (LED) comprising:

driving said light emitting device with a driving circuit (Fig. 1, various resistors, capacitors, and transistors driving the LED)

While disclosing bandwidth compensation for the LED, *Numata* does not expressly disclose generating a signal having a frequency response output curve manifesting an opposite property relative to the property of a frequency response curve of said light emitting device.

Eskeldson discloses pole-zero compensation for an element with an undesired bandwidth limitation. Fig. 8b illustrates the frequency response of the device to be compensated. Fig. 8a shows the frequency response of the compensating circuit, which is an RC circuit as disclosed by *Numata*. Inspection of Fig's. 8a and 8b shows that the frequency response curves are opposite each other.

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to adjust the compensation circuit disclosed by *Numata*, such that its frequency response curve is opposite the frequency response of the LED. *Numata* suggests bandwidth compensation for the LED.

As to **Claim 5**, *Numata* discloses said driving step comprises driving the LED with an output signal generated by a power amplifier (Fig. 1, compensator 11 and transistor Q12.)

Eskeldson discloses that the frequency of compensation zero is controlled by a known relationship (Col. 6, ll. 52-6.)

It would have been obvious to set the gain curve of the driving circuit to start from the cut-off frequency of the LED. A person of ordinary skill in the art would have been motivated to optimize the frequency of the compensation circuit that produces the best result.

As to **Claim 6**, *Numata* discloses said driving circuit comprises a power amplifier having an output signal (Fig. 1, compensator 11 and transistor Q12.)

said amplifier comprises: a frequency generating unit for generating a signal at a desired frequency (Fig. 11, frequency set by known relationship)

a current multiplier unit constituted by a current mirror circuit (Fig. 1, 13);

and a discharge circuit for applying a reverse current distributed from said current multiplier unit to said light emitting device (Fig. 1, 14, constant current source applies current I_d which is a reverse current to the LED.)

Eskeldson discloses that the frequency of compensation zero is controlled by a known relationship (Col. 6, ll. 52-6.)

It would have been obvious to set the gain curve of the driving circuit to start from the cut-off frequency of the LED. A person of ordinary skill in the art

would have been motivated to optimize the frequency of the compensation circuit that produces the best result.

As to **Claim 8**, *Numata* discloses the step of driving said light emitting device with said driving circuit comprises:

generating an LED drive signal having a gain curve manifesting said frequency response output curve, (Fig. 1, various resistors, capacitors, and transistors driving the LED) said generating the drive signal with a power amplifier which includes a frequency generating unit (Fig. 1, 11) and a current multiplier unit constituted by a current mirror circuit for generating a reverse current (Fig. 1, 13 current multiplier multiplies the input current by a desired amount); and

distributing the reverse current from said current multiplier unit to said light emitting device (Fig. 1, current source 14 provides reverse current to LED when input signal is low.)

Eskeldson discloses that the frequency of compensation zero is controlled by a known relationship (Col. 6, ll. 52-6.)

It would have been obvious to set the gain curve of the driving circuit to start from the cut-off frequency of the LED. A person of ordinary skill in the art would have been motivated to optimize the frequency of the compensation circuit that produces the best result.

As to **Claim 10**, *Numata* discloses an optical communication apparatus (interface, Col. 1, ll. 25-30) equipped with a light emitting device circuit specified in claim 1 (as discussed in the rejection for claim 1.)

As to **Claims 11 and 12**, it is known in the art (bode plot construction of the transfer function) that a zero increases the gradient of the transfer function by 20db/dec, which is the same as 6db/oct. The suggestion/motivation is the same as that used in claims 2 and 5.

As to **Claim 14**, *Numata* discloses a light emitting device circuit comprising:

a light emitting device (LED) (Fig. 1, 15) exhibiting a first frequency response curve having a first frequency cut off point (Col. 2, ll. 15-24, cut off of about 100MHz), the response curve decreasing in magnitude with respect to the first frequency cut off point (this is known to decrease in magnitude, which is why the frequency response must be compensated for); and

a power amplifier for generating a drive signal for driving the LED (Fig. 1, 11 and Q12), the drive signal manifesting a second frequency response curve having a second frequency cut off point (Col. 3, ll. 25-31; the bandwidth limitation of the LED is compensated by the compensation circuit, thus the driving circuit must have a 2nd frequency response curve property),

While disclosing bandwidth compensation for the LED, *Numata* does not expressly disclose the second curve increasing in magnitude with respect to the second frequency cut off point such that the frequency cut off point of the LED in

response to being driven by said drive signal is significantly greater than the first cut off point.

Eskeldson discloses pole-zero compensation for an element with an undesired bandwidth limitation. Fig. 8b illustrates the frequency response of the device to be compensated. Fig. 8a shows the frequency response of the compensating circuit, which is an RC circuit as disclosed by *Numata*. Fig. 8E shows that with compensation the frequency response of the LED is higher than it would have been without compensations (Fig. 8D.)

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to compensate the frequency response (*Eskeldson*) of the LED disclosed by *Numata*, such that the cutoff point of the LED is significantly greater than when not compensated. *Numata* suggests bandwidth compensation for the LED.

As to **Claim 15**, *Eskeldson* discloses that the frequency of compensation zero is controlled by a known relationship (Col. 6, ll. 52-6.)

It would have been obvious to set the gain curve of the driving circuit to start from the cut-off frequency of the LED. A person of ordinary skill in the art would have been motivated to optimize the frequency of the compensation circuit that produces the best result.

As to **Claim 16**, it is known in the art (bode plot construction of the transfer function) that a zero increases the gradient of the transfer function by 20db/dec,

which is the same as 6db/oct. The suggestion/motivation is the same as that used in claims 2 and 5.

As to **Claim 17**, *Numata* discloses wherein the power amplifier comprises a first signal generating unit (Fig. 1, 11) for generating a current output signal at a given frequency (Fig. 1, frequency controlled by known relationship) and a current multiplier unit for multiplying the value of the current output signal for driving the LED (Fig. 1, 13.)

As to **Claim 18**, *Numata* discloses wherein the current multiplier includes a current mirror circuit (Fig. 1, 13, current mirror.)

As to **Claim 19**, *Numata* discloses a discharge circuit for coupling the current multiplier unit to the LED (Fig. 1, current source 14 provides reverse current to LED when input signal is low.)

3. Claims 7, 9, 13, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,728,494 B2 to Numata et al. and U.S. Patent 6,864,761 B2 to Eskeldson et al., as applied to claims 6, 8, and 19 above, and further in view of U.S. Patent 4,723,312 to Yamashita et al.

As to **Claim 7**, *Yamashita* discloses said discharge circuit includes a capacitor (Fig. 3, 82) for outputting the distributed current from a drive circuit to said LED (Col. 2, ll. 55- Col. 3, ll. 10), wherein:

a voltage source (Fig. 3, 52) having fluctuations in its voltage or impedance synchronized with the driving current of the output signal of said

driving circuit is connected to said terminal (the voltage follows the drive current as the drive current passed through this transistor)

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to use a discharge circuit and voltage source (*Yamashita*) in the LED driver disclosed by *Numata*, and to connect it between the current mirror and the LED. *Numata* suggest a similar discharge circuit. The circuit disclosed by *Yamashita* reduces the fall time of the transmitted signal.

As to **Claim 9**, *Yamashita* discloses said distributing includes distributing the reverse current with a discharge circuit (Fig. 3, 101) for outputting the distributed current (Col. 2, ll. 55- Col. 3, ll. 10.)

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to place the discharge circuit disclosed by *Yamashita* between the current multiplier unit and the LED to discharge the current from the multiplier unit. The suggestion/motivation would have been to decrease the fall time of the signal.

As to **Claim 13**, *Yamashita* discloses the reverse current is distributed by a capacitor (Fig. 3, 82.) The suggestion/motivation is the same as that used in the rejection for claim 9.

As to **Claim 20**, *Yamashita* discloses a discharge circuit including a capacitance coupled between the driver and the LED.

At the time of the invention, it would have been obvious for a person of ordinary skill in the art to use the capacitor (*Yamashita*) between the LED and the

driver (current multiplier) disclosed by *Numata*. The suggestion/motivation would have been to reduce the fall time without affecting the rise time of the signal.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL G. DOBSON whose telephone number is (571)272-9781. The examiner can normally be reached on Mon. - Fri. 8:00 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Vanderpuye can be reached on (571) 272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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